Integrating Climate Change into a Prioritization of Land Parcels for Conservation in the Matanuska-Susitna Borough

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Vulnerability Index

Vulnerability to climate change is influenced by climate change exposure, sensitivity to change, and adaptive capacity (IPCC). For general landscape planning, sensitivity and adaptive capacity can be represented as landscape resilience with variables related to connectivity, land protection, and diversity (Magness et al. 2012). Spatial variation in climate change exposure and landscape resilience can be used to craft a suite of adaptation strategies that can coordinate divergent approaches and spread risk across

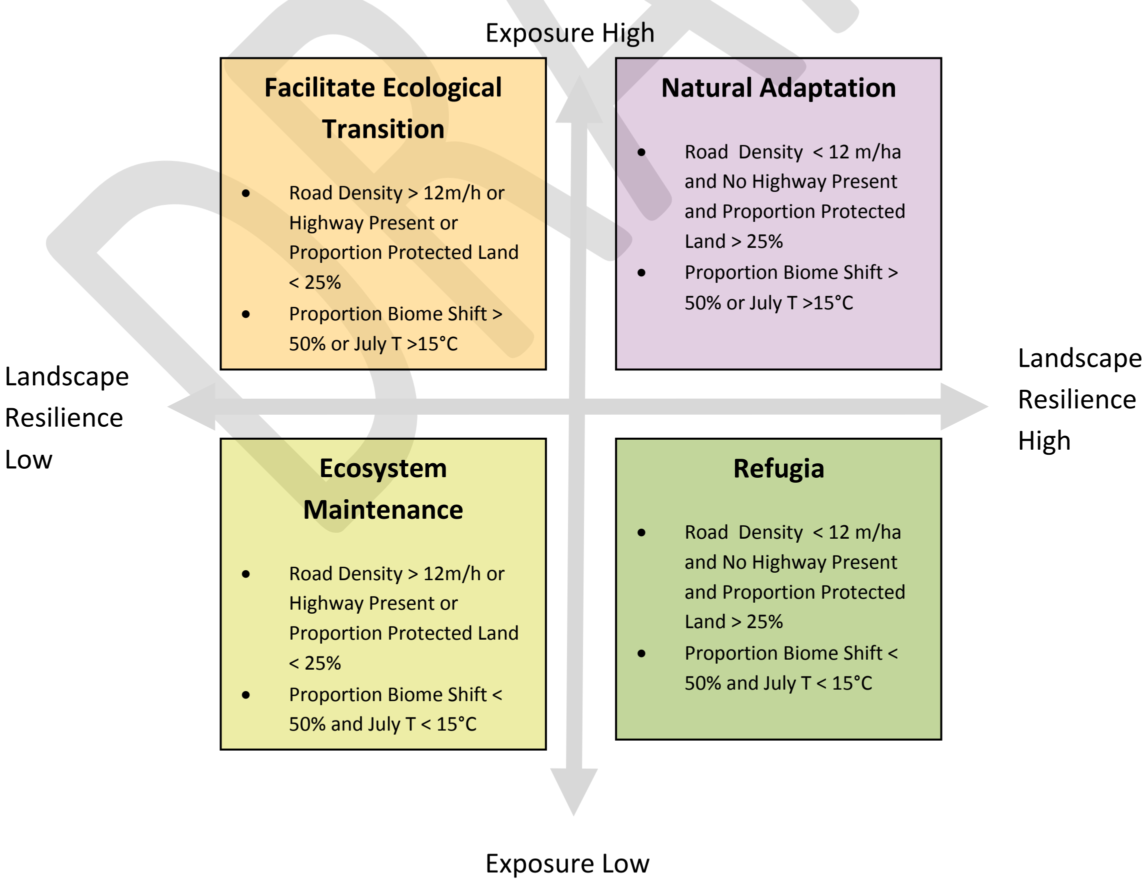


Figure 1.

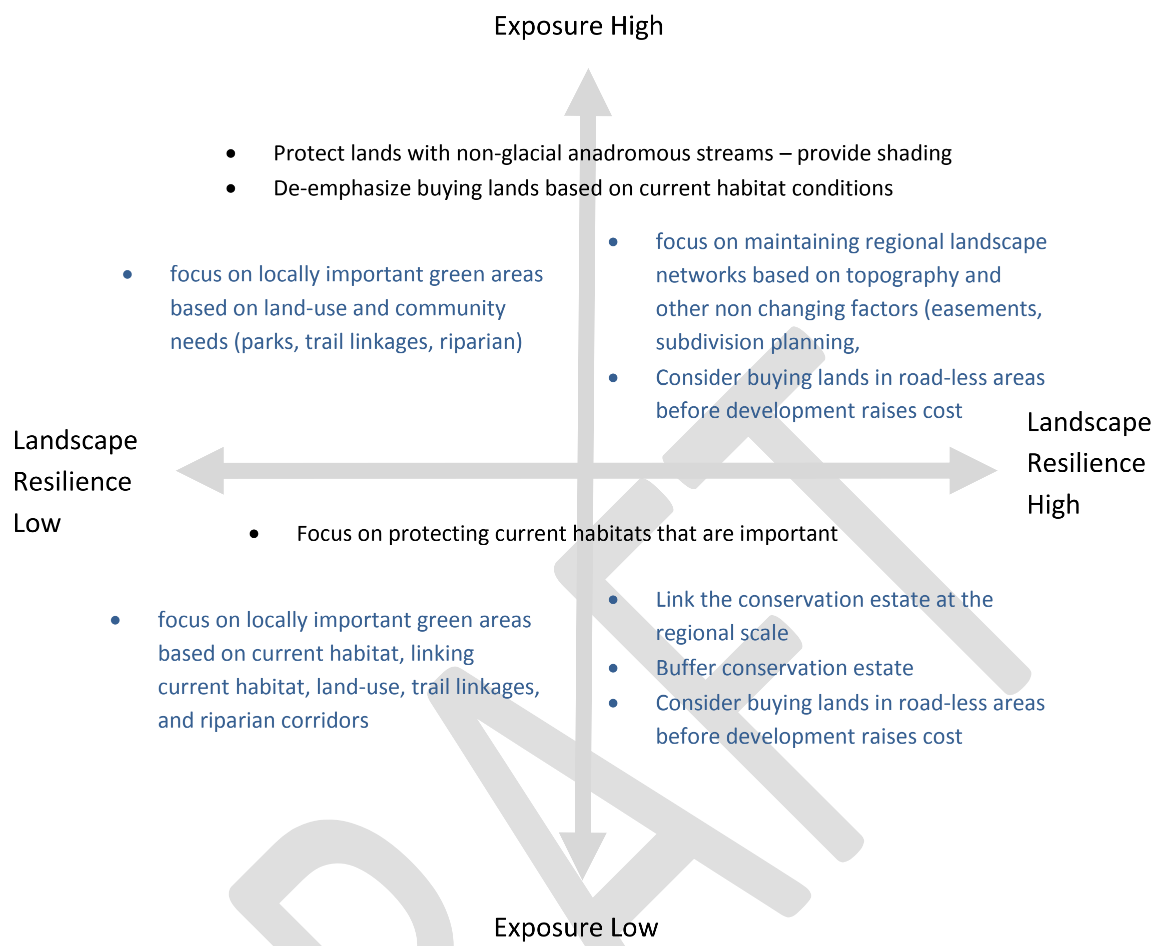
the landscape (Magess et al. 2012).

For the Matanuska-Susitna planning area we binned sub-watersheds into 4 categories based on their relative exposure and landscape resilience (Figure1). We used a forecast of biome shift and July mean temperature in 50 years under the a1b emission scenario to assess climate change exposure. SNAP (2012) identified X biomes based on climate variables in Alaska and forecast the location of the climate space linked to each biome in 2060 using GCM projections. We identified pixels where the climate space had shifted to a different biome in 2060 and calculated the proportion of each sub-watershed forecast to change. July temperature has been linked to salmon health with incubation and spawning habitat being stressed when a threshold of 15°C is exceeded. We calculated the average July temperature of each sub-watershed in 2060 and identified areas forecast to be > 15 °C. Sub-watersheds with >50% of their area forecast to change biome or with > 15°C mean July temperature in 2060 were categorized as having high exposure.

We used roads and the conservation estate to assess landscape resilience. We identified sub-watersheds with >12m/ha road density or that included highway have having lowered resilience. The 12m/ha is doubled the road density threshold where large mammals decline (Forman et al. 1996). Highways can limit wildlife movement and be a vector for invasive species (Foreman 1995). Protected lands increase landscape resilience because there is less anthropogenic pressure in these areas. We used a threshold of 25% protection because it has been suggested as a conservation goal for biodiversity protection (Noss 1996). We calculated the proportion of each sub-watershed in the conservation estate. We defined sub-watersheds with >25% protection, < 12m/ha of road, and no highways present as having high landscape resilience. In the Matanuska-Susitna borough, areas with low resilience may still be roadless and undeveloped. These areas may provide unique, long-term planning opportunities to secure lands into the conservation estate before development increases the cost.

Land Buying Rationale Based on Vulnerability

Different land buying strategies or prioritization weights may be applied to parcels based on sub-watershed vulnerability category (Figure 2).



Technical Appendix

Programs Used

1. ArcMAP 10
2. XTools Pro
3. Geospatial Modeling Environment

Data Sources

- Anadromous Stream Catalog for Alaska
- Conservation Biology Institute. 2010. PAD-US 1.1 (CBI Edition). Protected Areas Database. http://consbio.org/products/projects/pad-us-11-cbi-edition
- Great Land Trust Southcentral Alaska. 2010. 2010_Matsu_Pri Geodatabase. From the "A Prioritization of Land Parcels for Conservation in the Matanuska-Susitna Borough" Project
- Matanuska-Susitna Borough. 2012. Road Layer. http://www.matsugov.us/it/downloads

- Scenarios Network for Alaska & Arctic Planning. 2012. Projected Derived Temperature Products. http://www.snap.uaf.edu/data.php
- Scenarios Network for Alaska & Arctic Planning. 2012. Outputs from the Alaska-Canada- Climate-Biome shift Project. http://www.snap.uaf.edu/project_page.php?projectid=8#downloads. Data from Nancy Fresco, SNAP Coordinator

Processing Steps

Road Density

1. Uploaded Alaska Road shapefile from the Mat-Su Borough website
2. Extracted shapefile of the Sub-watersheds in study area from the 2010_Matsu_Pri Geodatabase
3. Used XTools Pro to add acres to HUC sub-watershed shapefile.
4. Used GME [sumlinelengthsinpolys] to calculate length of all roads and highway in each
5. Calculated m/ha of road for each subwatershed. Identified

Proportion Protected Area

1. Uploaded the PAD-US 1.1 protected lands database.
2. Selected lands with a GAP Status of “Permanent Protection” or with an Owner Type of “BLM”
3. Exported selected lands and merged with the Protected_Areas_CMS3 layer in the 2010_Matsu_Pri Geodatabase
4. Clip to study are boundary and dissolve protected lands into one shapefile
5. Calculate the proportion of sub-watershed protected using GME [isectpolypoly]

Forecast Cliome Change

1. Upload Cliome geotiff files from the Baseline1961-1990 and the 5modelAvg_a1b_2060_69.
2. Use Raster Calculator in ArcMap to identify pixels that were not equal when comparing the baseline to future climate
3. Use GME [isecpolyrst] tool to calculate the proportion of each sub-watershed forecast to transition

Salmon July Temperature Threshold

1. Upload Decadal Temperature Summaries for the a1b 5-model average from the SNAP website
2. Use GME [isecpolyrst] to calculate the average temp in 2060-69 for each subwatershed